Prof.r J. Hughes Bennett
with the best regards of his old pupil
the author

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Observations upon the action of Ipecacuanha and its alkaloid Emetia. By Dyce Duckworth, M.D. Edinb.

I WAS induced to make some enquiries as to the properties of Emetia, in consequence of the difficulty sometimes experienced in procuring the action of emetics in young children. For example, all who have had to minister to cases of infantile bronchitis must know how tedious, and oftentimes impossible, it is to cause vomiting, and induce beneficial effects therefrom. It occurred to me that by the subcutaneous method of injecting drugs it might be possible to bring about this result.

The explanation of this difficulty I take to be as follows. In most of these cases the emetic substances employed do not reach the mucous membrane of the stomach. Either from a catarrhal condition of the membrane itself (a concomitant of the more urgent bronchial affection), or, owing to mucus coughed up and again swallowed, the proper absorptive function of the stomach is well nigh abrogated. In such cases to give, as is so often done, ipecacuanha, sulphate of zinc, or mustard, and to secure such subsequent ingestion of warm fluids, at intervals, as may even visibly distend the stomach, avails nothing. Neither in some instances does the plan of tickling the fauces prove more effectual in conjuction with other measures, and in such circumstances it would seem that natural reflex sensibility was blunted.

It is nearly two years since I determined to employ the active principle or, more strictly, the alkaloid of ipecacuanha, called emetia, to induce vomiting in these and like cases. I proposed to inject it under the skin, in the form of solution, believing that it might in this manner reach the circulation with certainty and rapidity. I may state that I did not commence my enquiries into the subject until my colleague, Dr. Gee, was engaged in studying the action of the new morphia products discovered by Dr. Matthiessen, and in particular the base called apomorphia. The remarkable properties of this agent, when subcutaneously employed as an emetic, led me to

carry out my experiments with emetia, since it seemed a matter of interest to investigate whether we were not already in possession of an alkaloid which was capable of more extended employment in the same direction.

Having found several discordant statements in the writings of those who had previously studied the actions of ipecacuanha and emetia, my attention was, in the first instance, directed to these, and therefore in the present paper I purpose to deal exclusively with the action of this substance in doses more or less poisonous. I have the notes of many other experiments on the local and medicinal effects both of ipecacuanha and emetia, but as I hope to extend my enquiries further, I may embody them in a future communication. It may be sufficient to premise and state here that the hypodermic injection of emetia is quite successful in inducing vomiting, but I forbear, for the present, to recommend its employment in this fashion, till I am better satisfied that the solutions do not act in too irritant a manner at the site of injection.*

It appears that pure emetia has seldom been used by physiologists or therapeutists. An impure or so-called medicinal emetine has been more largely employed, especially in France. The alkaloid is an amorphous substance, having the colour of scammony powder. It is devoid of odour, and has a bitter taste, which most resembles that of opium or gentian. It is hardly soluble in water, except it be hot; quite soluble in alcohol and in acids. A solution of gr. j. in fl℥j. of distilled water, slightly acidulated with acetic acid, has a bright, sherry colour, and the odour of laudanum. It is a costly substance, fifteen shillings a drachm being the present price. The cortex of the ipecacuanha root furnishes the bulk of it, very little being obtained from the meditullium.

In the analysis of this root by Pelletier,† about 16 per cent. of 'matière vomitive' was found. This, however, corresponds to the medicinal emetia or extractive, as usually furnished in the shops. I learn that an ounce of powdered ipecacuanha yields about two grains of the pure alkaloid, or in bulk, as prepared, from four to six ounces are procured from a hundred pounds of the root.‡ Messrs. Herrings supplied me with the specimen of the emetia with which I have experimented.

* I may mention that when the alkaloid is applied in powder to the conjunctiva, severe inflammatory symptoms rapidly ensue.

† 'Formulaire,' etc., par F. Magendie, p. 78, 7ème édit. Paris, 1829.

‡ Mr. Williams, of New Cavendish Street, furnished this information for me to Messrs. Herrings.

I employed several of the tests for this according to the directions of Magendie,* and found the substance to respond exactly to them. The most important one I mention, since it constitutes the best antidote to this poisonous agent.

Tincture of galls throws down a dense precipitate from a solution of emetia, a tannate of the alkaloid, according to Pereira,† being formed.

Magendie quotes a case where a timely use of this sufficed to prevent the emetic action of the drug; and, as will subsequently appear, I have sometimes detected emetia in the urine of animals poisoned by it, by means of this simple test.

We are indebted for most, if not all, our knowledge upon the action of emetia to the labour of Magendie and Pécholier. The latter has recently published his observations made at Montpellier.‡ Trousseau and Pidoux quote them,§ and as I have been unable to find the original papers, I take their statements.

My experience of the effects of emetia is at variance in some points with that recorded by M. Pécholier. This observer remarked a diminution in the numbers of the pulse and respiration, also a peculiar bleached and exsanguine condition of the lungs after poisoning with this substance. I was not aware of the first observations until I had made several of my experiments. The latter statements I knew were on record, and sometimes quoted indeed in support of the theory that ipecacuanha acted as a styptic in pulmonary and some other internal hæmorrhages. Trousseau and Pidoux state this in so many words.‖

In my cases the respiratory movements were increased in frequency, and the cardiac action was not less rapid than in health. As to the condition of the lungs, as will be seen from my post-mortem accounts, there was always more or less engorgement with blood, and in one case even lobular pneumonia set up. My observations thus confirm those of Magendie, who, forty years ago, described the congested lungs met with in poisoning by emetia. Hence I believe, it may be asserted that whatever styptic power ipecacuanha may possess over pulmonary hæmorrhage, of which I have as yet no clinical

* Op. cit. p. 78.
† 'Mat. Med.' vol. ii. pt. i. p. 1595.
‡ 'Montpellier médical,' nov. et déc. 1862.
§ 'Traité de Thérapeutique,' tome i. p. 737, 8ème édit. Paris, 1868.
‖ Op. cit. p. 743. See also Art. Ipec. in Waring's 'Manual of Therapeutics.' Churchill, London.

experience, is not to be explained on the theory that this agent induces an anæmic condition of the lungs.

Sundelin,* a Berlin professor and physician, who wrote a book upon pharmacy, quoted by Pereira, has ingeniously ascribed the condition of the lungs met with after emetia poisoning, not to the specific stimulus exerted by this agent on the pulmonary mucous membrane, but to an exhausting stimulus over the eighth pair of nerves, by which a condition similar to suffocative catarrh is brought on. This theory merits some attention. We know that ipecacuanha has special influences on the parts supplied by the par vagum, and we know too that division of, or injury to, the branches of this pair of nerves causes a series of changes in the lung textures which, commencing with congestion, may pass on to a destructive form of pneumonia.†

That there is a similarity in the appearance seen in the lungs of animals whose vagi have been divided, and those who have died of emetia poisoning, I have satisfied myself, so far as the results in one experiment permit me to speak.‡

These experiments are not easily made, and indeed the deductions from the phenomena witnessed, both during life and after death, are not free, even in the light of the most advanced physiological research, from some error. For instance, the more intimate connection of the vagus with the sympathetic in the dog and cat, than is the case in man, would probably modify the results observed.

It is impossible, however, not to see that much light may ere long be thrown upon this difficult question. The recent investigations of my friend Professor Rutherford, of King's College, upon the influence of the vagus upon the vascular system,§ seem to indicate the method in which these and such like enquiries should be approached and worked out. If it be permissible to frame an hypothesis as to the action, or at all events a large part of the action, of ipecacuanha or its alkaloid, founded upon these most recent physiological deductions, then I think we may regard this drug as promoting, after its absorption into the blood, the following nervous influence. Believing 'that the vagus, like most afferent nerves, contains filaments which produce vascular contraction, as well as those

* 'Handbuch der speziellen Heilmittellehre,' Band ii. p. 38. Berlin, 1825.

† Kirkes 'Physiology,' 6th edit. p. 526.

‡ Compare e.g. Experiments XIV. and XVIII. with XXI.

§ Influence of Vagus upon the Vascular System, 'Journ. Anat. and Phys.' vol. iii. Humphry and Turner, 1869.

which bring about dilatation,'* we may conceive that the circulation of emetia so affects the peripheral extremities of the vagus, that its vaso-inhibitory branches are thrown into action. From this there result inaction of the motor branches, and a condition of paralysis, or passive dilatation, of the blood-vessels presided over by this nerve.

This would explain the congestions of the lungs and gastro-intestinal mucous tracts.† To these special nervous influences must, I believe, be added the results of the general muscular prostration induced by emetia. This is always very remarkable. A decidedly sedative effect is rapidly induced. Magendie observed a disposition to sleep, but I doubt if there is truly a soporific action in poisonous doses; more probably there is a condition akin to, if not identical with, collapse, and this is rendered not unlikely because of the profound impression made on the abdominal nerve centres through the severe gastro-enteric irritation. Again, there is certainly chilliness of surface observable. I have several times noted this, and am glad to confirm M. Pécholier's remarks on this point. I have ascertained by the thermometer the difference between the axillary temperature and that of the rectum in some instances.‡

I have not observed any noteworthy changes in the brain or medulla oblongata in the few instances in which I looked for them.§

There is reason to believe that the physiological action of emetia varies according to the condition of the stomach, and in this way. The stomachs of rabbits are, I believe, never found empty, even after long fasts. The rodents do not vomit, and emetics have no effect upon them. Cats and dogs, on the other hand, readily vomit. Of course the presence of food in the stomach diminishes to some extent the amount and rapidity of absorption in the case of rabbits, but there is the advantage that all the poison is retained, and not ejected. Hence, on the whole, the morbid appearances in the rodents

* Influence of Vagus upon the Vascular System, 'Journ. Anat. and Phys.' vol. iii. p. 415. Humphry and Turner, 1869.

† Lest it be thought that this theory supposes a too wide anatomical distribution of the vagus, I may state that the late Prof. Goodsir used to teach that this nerve sent on its branches to blend with all the various plexuses of the sympathetic in the abdomen, so that its influences reached even to the rectum. (Lectures at Edin. 1859–61.)

Since writing the above note, however, Prof. Rutherford has informed me that it is possible there may be vaso-inhibitory filaments for the intestine in the ordinary spinal nerves. I trust to recur to this point, as well as to consider the secretory changes in the intestine, in my next paper.

‡ Experiments VIII., XIV.

§ Experiments XIII., XIV.

are the more interesting as illustrating the full effects of the drug. A cat ultimately dies from the same dose that kills a rabbit, but there has certainly been vomiting of much of the poison, if exhibited by the mouth, and hence the animal has succumbed in this instance to a smaller amount of the drug. If hypodermically introduced, no doubt also some of the poison is removed by the copious vomiting. This consideration, if followed out, would lead to the purely physiological question as to the immediate cause of the vomiting set up by emetic substances when injected into the veins, or under the skin. It seems to be still an undecided point whether the disturbance originates in central change in the medulla oblongata, or in a more local one at the gastric peripheral branches of the vagi, for the disturbing agent reaches centre and extremity, in all probability, at the same time. We know that vomiting may be induced from irritation of one or the other.

It appears that emetia produces most marked effects upon the lungs in the rabbit, and less upon the alimentary canal, while the reverse holds good for the dog, cat, and guinea-pig. The most extreme pulmonary congestion was produced in Experiment VIII., while in Experiments III., XVII., XVIII., and XIX., that seen in the intestines was the most noteworthy. The longer the animal survived, as a rule, the more marked was the intestinal congestion.

I made one experiment to try and determine whether section of the vagi in the neck would prevent the vomiting after injecting emetia subcutaneously. For the sake of comparison, another animal was similarly treated at the same time, and not injected with emetia. In these experiments, XX. and XXI., the results agree with those observed by the late Professor John Reid of St. Andrews,* so far as the respiratory organs are concerned. Neither of the animals operated upon actually vomited, though one of them, Experiment XXI., had severe retching. This was a common symptom in Reid's cases. The effects of emetia were therefore not manifested as usual as regards vomiting in XX., though the prostration of the animal, and the extreme coldness of surface, were not at all seen in the unpoisoned case. Death occurred also some hours sooner in the former instance.

Clearly, then, section of the vagi prevented vomiting. The lung changes were due probably to mixed causes. No gastro-intestinal congestion was produced. This I conceive to be a

* 'Phys. Anat. and Path. Researches.' Edin. 1848.

point of interest. In Rutherford's experiments there was always seen a marked bleaching of the stomach after section of the vagi during digestion. This fact would rather go to prove that the incident vaso-inhibitory filaments had been cut off from their central cells, and that it is through the vagus that emetia produces its effects. I should not lay too much stress on this explanation, however, especially on the strength of one experiment, and also because, as already stated, the gastro-intestinal congestions are among the later lesions induced by this poison.*

The frequency of occurrence of albuminous urine in emetia poisoning is noteworthy, and does not appear to have been previously noticed. It may possibly be akin to the albuminuria of pneumonia.

Experiments with Emetia.

'Experimenta per mortes agunt.'
Plin. Hist. Nat. xxix. 8.

Experiment I.—Injected ♏ v. of solution of emetia (gr. $\frac{1}{24}$) into axilla of strong guinea-pig. No noteworthy effects observed subsequently; the animal continued to eat, and appeared unaffected.

Experiment II.—Injected ♏ xxv. of same solution (gr. $\frac{1}{8}$) into axilla of another guinea-pig. Nothing remarkable observed afterwards.

Experiment III.—Gave gr. j. made into a bolus with bread and milk to guinea-pig. Sedative effect produced. Death in about ten hours. Post-mortem. Rigor present, toes livid. Yellowish fluid oozing from mouth. Lungs congested, not dark, crepitant, and floated on water. No pleural effusion. Pericardium natural. Heart, all cavities distended with dark coagula. Trachea and bronchi a little injected. Stomach, full of green pultaceous matter; mucous membrane pink and injected. Duodenum and whole tract of small intestine somewhat congested. Liver, distinct signs of engorgement of hepatic venous radicles. Kidneys natural. Bladder contained clear urine, which with heat and nitric acid was a little coagulable. Tc. Gallæ precipitated emetia very copiously, and nitric acid and ammonia subsequently added, reddened this slightly.

Experiment IV.—Injected gr. $\frac{1}{12}$ into axilla of small terrier bitch previously fed. In about fifteen minutes retching com-

* Experiment XX. The animal died in ten hours. The pallor of the liver and kidneys was very remarkable.

meneed, and a general sedative effect was notieed. The animal also snorted very much. No vomiting ensued.

Experiment V.—Injeeted gr. $\frac{1}{12}$ in solution into reetum of same bitch previously fed. No remarkable effects produced.

Experiment VI.—Injeeted gr. $\frac{1}{3}$ into reetum of same animal. In an hour and forty minutes she vomited once freely, having been very quiet for half an hour previously. No retching. The vomiting eontinued at intervals for ten or twelve hours, with marked depression and sedative effeet. Extremities and ears beeame cold. No tenderness of belly apparently. For several days afterwards the animal refused food, and seemed feeble and out of eondition.

Experiment VII.—Injeeted gr. $\frac{1}{12}$ under skin of small rabbit. Sedative effect prodneed.

Experiment VIII.—Injeeted gr. $\frac{1}{2}$ into reetum of same rabbit. Some of the solution was lost during the operation. Distinet sedative effeet at onee notieed. Animal refused food, and was purged. Remained quiet in one plaee, breathing hurriedly, 88 per minute. Great depression. Eyes half elosed. Temperature of reetum 101° F. (blood on thermometer on withdrawal), in axilla 100° F. Death in forty-five hours. *Sectio* in fourteen hours. Some blood-stained fluid in both pleuræ. Lungs, emphysema in parts, some scattered patehes of lobular pneumonia, granular on fraeture; some lobes reddened and eonsolidated, sinking in water. Traehea not much injeeted, bronehi eontained some reddish fluid, no froth. Heart, all eavities eontained dark elots. Blood throughout the body mostly eoagulated. Liver, congested in its portal system. Spleen and kidneys not remarkable. Stomach full of green food; mucous membrane softened and pale. Reetum reddened and inflamed, bowel above this, for several inehes, eongested and with mueh free sliny mueus on its surface. Some elear yellow urine in bladder, albuminous, aeid. Tc. Gallæ eaused a precipitate. Free tesselated epithelium and granular matter on microseopieal examination, no blood discs.

Experiment IX.—Injeeted gr. $\frac{1}{6}$ emetia into back of cat. In fifteen minutes it vomited twiee. During next two days seemed depressed and out of eondition. At the expiration of this time I made

Experiment X., and injected gr. $\frac{1}{12}$ more under the skin. Vomited in about fifteen minutes. Occasional cough and drivelling from mouth. Marked depression all next day. Five days afterwards two ulcerated surfaces seen at the points of injection.

Fig 1

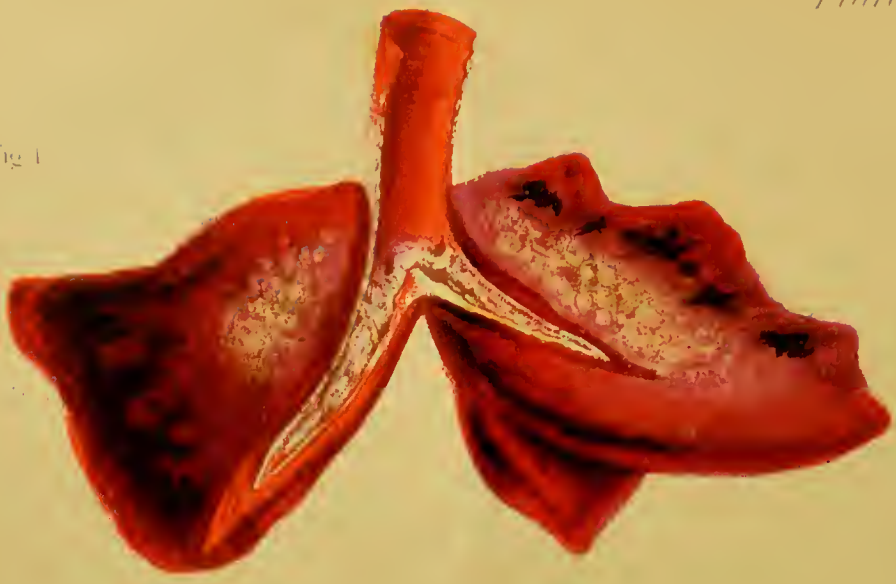


Fig 2.

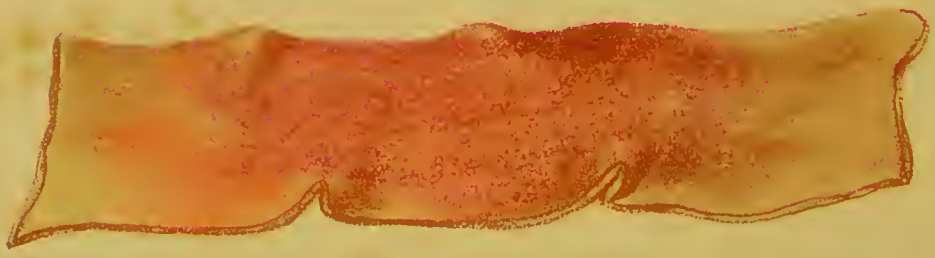
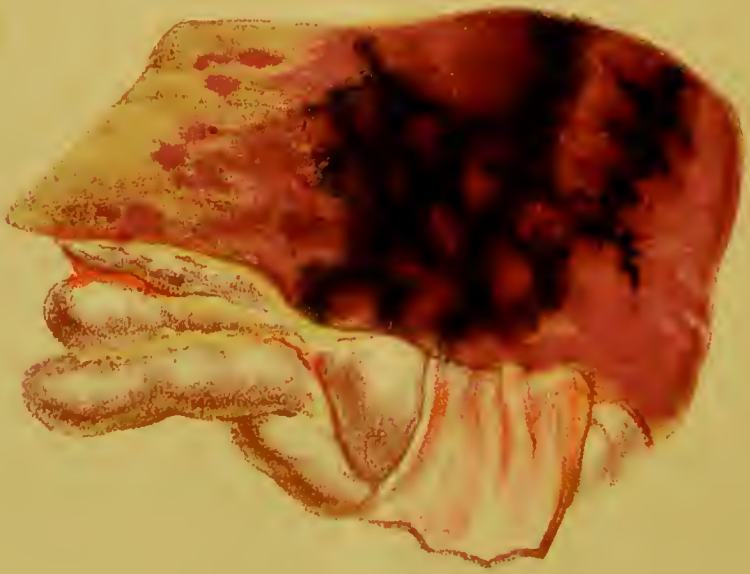


Fig 3.



Experiment XI.—Injected gr. $\frac{1}{6}$ into back of rabbit. Sedative effects followed, and refusal of food. No sign next day of irritation at site of injection. [Several of these experiments were made to determine the local effects of emetia when subcutaneously employed, and will be referred to again.]

Experiment XII.—Injected gr. $\frac{1}{20}$ in two places on back of large rabbit. Usual symptoms ensued. Ecchymoses found next day at the sites of injection.

Experiment XIII.—Gave gr. j. mixed with bread to a large rabbit. Immediate sedative effects noticed, and these continued to the time of death, which occurred within eighteen hours. The animal ate some food during the day. *Sectio* in thirty hours. Body found lying on belly; rigor passing off. A little clear fluid in each pleura, and in pericardium. Lungs deeply red and congested in several lobes, especially at anterior portions. Pallor for the most part at the roots. [This was easily explained by the position of the body for so long after death.] The darkest portions of the lungs sank in water. Trachea injected and of vivid crimson colour. This congestion ceased somewhat abruptly just beyond the bifurcation of the bronchi. Small tubes filled with frothy serum, also more injected than natural. (Plate VI. fig. 1.) Heart, all cavities distended with dark coagula, vena cava also. Some fluid blood in thoracic aorta, less dark. Stomach distended with green pultaceous matter, which was mostly covered by a layer of shed mucous membrane, probably the result of post-mortem softening. No congestion, nor was any met with in the duodenum or remainder of intestinal tract. Rectum empty and not contracted. Liver, spleen, and kidneys natural. About fl. ʒj. of acid, turbid urine was found in the bladder, and proved to be highly albuminous. Te. Gallæ threw down a copious precipitate from it. Brain apparently natural.

Experiment XIV.—Injected gr. $\frac{1}{4}$ into rectum, gr. $\frac{1}{10}$ hypodermically, and gave gr. ij. by mouth to a large rabbit. In fifteen minutes the temperature in rectum was 103·5° F., in axilla in forty-five minutes 103° F. Breathing rapid. Profound sedative effect induced, so that the animal lay for hours in one place and position. Pupils unaffected. In six hours, the animal was lying on its belly, breathing 96 times per minute, and very feebly. Ears and limbs feel chilly. Temperature in axilla 98·4°, in rectum 100·5°, in mouth 97·4° F. Great muscular prostration, but can be roused to move a few paces. Can be rolled over, and lies in any position without resistance. During next two hours, continued prostration, breathing, over 140 in the

minute, becoming more diaphragmatic. Chest quite resonant on percussion. Paralysis of extremities, cessation of reflex action everywhere but in cornea, and this blunted, and relaxation of sphincters, with passage of pultaceous fæces. Death in eight and a half hours from time of administration of poison. Rigor mortis set in immediately. *Sectio* in fifteen hours. Rigor everywhere. Small ecchymoses at sites of subcutaneous injection. Lungs much congested throughout, especially left; (the animal died lying on left side, and remained in same position afterwards). No parts sank in water. Trachea and bronchi congested, and latter filled with frothy serum. No pleural or pericardial effusions. Heart, cavities filled with dark clot, except left ventricle, which was contracted. Stomach full of green food, enclosed in softened layer of mucous membrane, exactly as in Experiment XIII. General slight congestion of small intestine and great omentum. Rectum contained softened fæces, somewhat congested. Bladder natural, containing some turbid, alkaline urine. Liver, congestion of hepatic venous radicles. Kidneys and spleen natural. No peritonæal effusion. Brain natural.

Experiment XV.—Gave gr. ij. by mouth to a young cat. It vomited several times within half an hour, and for some hours afterwards. Bowels acted several times, and urine passed. Drivelling of saliva. Refused food, seemed prostrate, and breathed hurriedly. Death within eighteen hours. Body lying partly on belly and left side. *Sectio* in seventeen hours. Rigor well marked. Tied trachea. Lungs partly collapsed, and partly emphysematous. No congestion worthy of note, no consolidation. Trachea, slight arborescent injection with some thickened mucus on its surface. No frothy serum in bronchi. Heart, right side moderately distended with thick dark blood, no coagula. Left side empty, ventricle contracted. No effusion into serous sacs. Liver congested at centres of lobules. Stomach almost empty, mucous membrane slightly pink. Intestines slightly congested throughout, excess of rather thick mucus. Other viscera natural.

Experiment XVI.—Gave a large dog, weighing twenty pounds, unfed for twenty-four hours, gr. ij., with some raw portion of sheep's intestine. Next day, after drinking freely of some water, the dog vomited the meal of previous day, almost unchanged in appearance. No special symptoms observed.

Experiment XVII.—Injected gr. j. under skin of large cat. Vomiting and purging, followed with general sedative effect. In twenty-four hours continued torpor and prostration.

Gave another grain in solution by mouth. In two or three minutes, about an ounce of yellow, turbid, fœtid fluid was violently ejected from stomach. Increased torpor afterwards, and death within thirty hours. *Sectio* in eight hours. Rigor. Trachea tied. Lungs collapsed somewhat on opening thorax, congestion especially in right, portions collapsed with compensatory emphysema. Trachea and bronchi injected, of pinkish hue, with much bloody and frothy serum in smaller tubes. Some enlargement of bronchial glands. No parts of lungs sank in water. Heart slightly distended, with dark blood and some clot, and the same also in left ventricle. No effusions into serous sacs. Liver congested in centres of lobules. Gall-bladder not empty. Stomach contracted, mucous membrane a little congested, and covered with excess of sticky mucus. Small intestines deeply congested, covered with thick mucus in parts, especially towards end of ileum, where the vivid injection was less marked. Curdy masses of mucus in large intestines, chiefly adherent to surfaces of agminate glands, near cæcum. Great enlargement of mesenteric glands. No peritonæal effusion. Spleen natural. Kidneys fatty, congested around pyramids. Bladder contracted and congested, contained a few drops of thick creamy urine, which was coagulable.

Experiment XVIII.—Injected gr. j. under skin of large cat. Same symptoms as in XVII. In twenty-four hours, breathing shallow, feeble, and hurried. Marked prostration. Gave gr. j. by mouth. Death within thirty hours. *Sectio* in eighteen hours. Rigor. Ecchymoses at points of injection under skin. Lungs congested, collapsed in parts, and a little emphysematous. Same appearances as in XVII. Trachea slightly injected; abundant frothy serum in bronchi. Heart, right side, moderately distended with dark blood, less so on left side. No effusions into serous sacs. Stomach, cardiac end driven through the diaphragm, owing to violent vomiting, contracted and somewhat congested. Small intestine irregularly congested.* Some of Peyer's patches injected. Cæcum vividly congested, empty.† Large bowel only slightly congested, empty, but with excess of mucus. Bladder contracted, congested and empty. Liver congested in centres of lobules; gall bladder not empty.

Experiment XIX.—Gave same dog as employed in Experiment XVI. gr. ij.–iij. in solution by mouth. Sedative effect soon apparent. Severe vomiting and purging ensued, and continued next day. Food refused. Death in sixty hours. *Sectio* next day. Lungs much engorged, no collapse or emphysema.

* Plate VI. fig. 2. † Plate VI. fig. 3.

Trachea and bronchi injected, bloody and frothy serum in latter. All the cavities of the heart contained dark semi-clotted blood. Stomach contracted and empty, moderately congested. Entire alimentary canal empty and deeply congested, of a purple tint or dusky red in most parts. Vertical rugæ of rectum much congested. Liver greatly engorged. Spleen natural.

Experiment XX.—Mr. Richard Davy removed for me portions of both pneumogastric nerves, above the efference of the superior laryngeal branches, in the neck of a cat. On recovery from the effects of chloroform, the respiration was seen to be very laboured and slow. Spumous, bloody fluid came from the mouth and nostrils. The heart acted rapidly. I next injected subcutaneously a poisonous dose of solution of emetia. No retching or vomiting was observed. The animal seemed very prostrate, could not walk steadily, and rolled over on its side. The third eyelids passed quite half way across the corneæ.* In seven hours it was very cold; severe dyspnœa continued, and there was increased prostration. Abundant fine, soft crepitation and sibilation audible over both lungs behind. Death in ten hours. Body examined twelve hours subsequently. Ecchymosis at site of injection under skin, and in dorsal muscles. Trachea tied. Lungs much congested, especially the left. Emphysema anteriorly, collapse in some parts, and true consolidation in others; some pieces of the latter sank in water. Much bloody serum and froth in bronchi; trachea natural. No effusions into serous sacs. Heart contained dark clots and some fluid blood in all cavities, and an especially tough clot in left ventricle. Stomach contained partly digested food of an acid reaction, rather pallid than congested, and the same was the case with the whole alimentary mucous tract. Liver remarkably pale and bloodless. Kidneys fatty and void of usual amount of blood. Spleen natural. Bladder pallid, contained a little acid urine.

Experiment XXI.—Mr. Davy treated a small cat in the same manner as in Experiment XX. Similar phenomena were observed subsequently, but there was less difficulty in maintaining equilibrium, and less immediate dyspnœa. The third eyelids were affected as in last case. No emetia was injected. In seven hours the animal was quite warm. There had been retching, but not severe dyspnœa. In twelve hours, occasional retching continued. Some milk poured down the throat was at once ejected with some of the contents of the stomach. Tickling of fauces caused severe and immediate retching. Respiration

* This was first observed by Petit, and is quoted and confirmed by John Reid in his researches.

wheezing and difficult, occurring at lengthened intervals, head drawn back during inspiration. Abundant sibilation heard over both backs. Heart's action rapid. Death within twenty hours. *Sectio* in six hours. Trachea seemed more moist than natural. Lungs very congested and œdematous, emphysematous at margins. Darkest and non-crepitant parts sank in water. No granular appearance on section. Much bloody, frothy serum in bronchi. Heart contained dark coagula in all cavities but left ventricle. Dark clot in abdominal aorta. No effusion into serous sacs. Stomach partly occupied with pultaceous mass of cockroaches; mucous membrane natural. Intestines natural. Liver engorged, and very unlike that in last case. Kidneys bloodless on section. Bladder pallid.

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